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The Effect of KNO_3 on the Growth of Sorghum Plant (*Shorgum bicolor* var. numbu)

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Abstract The purpose of this research is to know the effect of giving KNO_3 on sorghum plant's growth (Shorghum bicolor var. numbu). This study was conducted a Complete Randomized Design by using four treatments (K1, K2, K3 and K4), each treatments did in five repetitions. K0 (without KNO_3= only aquades), K1 were given 15% KNO_3, K2 were given by 30% KNO_3, K3 were given 45% KNO_3 and K4 were given 60% KNO_3. Parameters measured were the number of leaves, the weight of wet leaves, the weight of dry leaves, malai's weight, and chlorophyll contents (a cholophyll, b chlorophyll, and total chlorophyll). Data analyzed by using ANOVA (Analysis of Variance) then continued by calculating honestly significant difference (Tukey –HSD Test) at 0,05 significanct level. The results show that there was a non-significant difference for all parameters of giving KNO_3. However, K4 treatment (60%) had significant difference for all parameters like; leaf-number, the weight of wet leaves, the weight of dry leaves, heavy malai. In spite of this, the chloropyll content on Sorghum plant did not show any significant results. This study still not shows the best result and maximum effects KNO_3 on Sorghum plant's growth. Hence, deeper assessment is much needed.

Keywords: *sorghum plant, KNO3, leaf-number, the weight of wet leaves, the weight of dry leaves, malai's weight, chloropyll content*

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1. Introduction

Sorghum is one of the cereal plants that can grow in various environmental conditions, especially on dry marginal land in Indonesia. Sorghum has advantages on broad adaptability, tolerance to drought, high productivity, and more resistant to pests and diseases than any other food crop. Sorghum plants have benefits such as food, feed, and industrial materials [1].

Other countries used sorghum seeds as food, animal feed and industrial raw materials. As a world food ingredient, sorghum is ranked 5th after wheat, rice, corn, and barley. In developed countries, sorghum seeds used as poultry feed, while the stem and leaves for ruminant livestock. Sorghum seeds are also industrial raw materials such as, ethanol, beer, wine, syrup, glue, paint and modified starch. Some countries such as America, India and China, sorghum sre used as raw material for the manufacture bioethanol fuel.

The production of sorghum in Indonesia is very low, even sorghum product is not available in the markets, to increase the production of sorghum, many ways that can be done,one of them is allocation of fertilizer. Fertilization is done with the aim to sufficient the nutrient availability that needed the plants in growth, so it will increase the production of the plants.

One of the fertilizer that used is the fertilizer that contains macro nutrients such as N, P, and K. K elements is very needed for carbohydrate metabolism such as formation, split, and starch translocation. The function of kalium is very important in plant physiology, act as essential enzymes activator in metabolism reaction and enzymes involved in starch synthesis. However the K concentration in the soil solution is only partially absorbed by the plants, the remainder released into the soil solution or attached strongly to the surface in the colloid soil. One of the fertilizer that can be used as K source for plants is KNO3 fertilizer. The nutrients that contains in KNO_3 are potassium and nitrogen that needed the plants for increase the growth. The N element that contains in KNO_3 is needed in large quantities for plants

Reference [2] said that K elements is the second macro nutrients after N that required by the plants. The K nutrients taken by the plants in the form of ion K+, K nutrient has a large hydrated elements and valvous 1, so this element is not strongly absorbed so it can be lost easily and washed in the soil. The K element are supplied into the ground in form of sea salt fertilizer such as KCl, KNaCl, K_2SO_4 dan KNO_3.

In the previous research, showed that KNO_3 solution able to break the dormancy of java acid effectively at the 0,4% concentration. Reference [4] showed that allocation of KNO_3 fertilizer up to 150 kg/ha produce the higher plants, more leaves, larger of leaf area index, larger dry

weights, the number of seeds per line higher, higher production and uptake pottasium compared with the control. Therefore, do the research about the effect KNO_3 on the growth of sorghum plants, in attempt to produce a certain quality animal feed.

This research is attempt to find out the effect of KNO_3 on the growth of sorghum plants (*Shorgum bicolor* var. numbu).

2. Material and Methods

This research was conducted at Botanical Laboratory of Biology Department, Faculty of Mathematics and Natural Sciences, University of Lampung. The research started from February to June 2018. Materials that needed to conduct this research are:

1. Land Preparation

At the stage of land preparation, begins with site celaning from weeds. Then do the grounding to be divided into several plots. The tools that used are hoes, knive, ruler, labael, pen, and marker.

2. Sorghum Planting

Plants is done on polybag, each different treatment using five polybags that planted five sorghum seeds.

3. KNO_3 Fertilizer Application on Sorghum Plant

10 ml KNO_3 Fertilizer were added to each plant after one week of planting. Giving KNO_3

fertilizer every two a days in the afternoon in each treatment.

4. Maintenance Work

The plants are watered every day and cleaning from weeds or pest that can inhibit plant growth.

This experiments were carried out in Complete Randomized Design with five treatments, each treatment consist of five replications. The steps of this research are :

1. Selection of good sorghum seed for growth.
2. Sorghum seeds are divided into 4 treatment:
   a. K1:0% KNO_3 concentration (control)
   b. K2: 30% KNO_3 concentration
   c. K3: 45% KNO_3 concentration
   d. K4: 60% KNO_3 concentration
3. On the ± 100 days observation.
4. Data Analysis was determine by *One Way ANOVA* (α=5%), if there are any differences, then continued with HSD test at 5% significant level.

Parameter that can be measured were number of leaves, the weight of wet leaves, the weight of dry leaves, malai's weight, and chlorophyll content of sorghum plant.

3. Results and Discussion

3.1. Results

Parameter that used to find out the growth of sorghum plant are the number of leaves, the weight of wet leaves, the weight of dry leaves, malai's weight, and chlorophyll content of sorghum plant (chlorophyll a, b, and total).

3.1.1. The Effect of KNO_3 on The Number of Leaves, The weight of wet leaves, and Dry Weight of Leaves of Sorghum Plant

The analysis results on Table 1 showed that KNO_3 on some concentration is no effect on number of leaves, the weight of wet leaves, and the weight of dry leaves. However, KNO_3 at the concentration 60% (K4) give the higher results compare with all treatments.

3.1.2. The Effect of KNO_3 on Malai's Weight of Sorghum Plant

The analysis results (Table 2) showed that KNO_3 at 15% concentration (K1) is not much different with control (without KNO_3). This just looks different at 60% concentration (K4), which gives higher malai's weight of sorghum plant.

Table 1. Average the number of leaves, the weight of wet leaves, and the weight of dry leaves of sorghum plant

KNO_3 concentration (%)	Average ± SD		
	The number of leaves (strand)	The weight of wet leaves (gram)	The weight of dry leaves (gram)
K0	23.60 ± 3.13 a	29.12 ± 6.50 a	7.00 ± 1.87 a
K1	22.80 ± 1.64 a	38.70 ± 4.96 a	14.20 ± 1.64 ab
K2	35.20 ± 6.53 bc	64.80 ± 9.44 b	21.60 ± 2.51 bc
K3	32.00 ± 10.7 ab	63.60 ± 16.66 b	22.20 ± 6.06 c
K4	44.00 ± 4.12 c	110.52 ± 16.85 c	32.40 ± 6.07 d

Average ± SD: Number of Average ± standard deviation.
The used of the same *superscript* letters on the same coloumn showed that no different results between treatment at 95% significant level.

Table 2. Average Malai's weight Sorghum Weight

KNO_3 Concentration (%)	Average ± SD
	Malai's weight (gram)
K0	2.37 ± 0.34 a
K1	2.38 ± 0.41 ab
K2	3.39 ± 1.25 ab
K3	4.40 ± 0.34 b
K4	7.13 ± 1.87 c

Average ± SD: Number of Average ± standard deviation
The used of the same *superscript* letters on the same coloumn showed that no different results between treatment at 95% significant level.

3.1.3. The Effect of KNO_3 on Chlorophyll Content of Sorghum Plant

The analysis results (Table 3) showed that KNO_3 at some concentration is no effect on chlorophyll content of leaves.

Table 3. Average Chlorophyll Content of Sorghum Plant

KNO_3 Concentration (%)	Average ± SD		
	Chlorophyll A (mg/l)	Chlorophyll B (mg/l)	Total Chlorophyll (mg/l)
K0	7.77 ± 0.79 ab	6.55 ± 0.35 ab	14.31 ± 1.14 ab
K1	7.66 ± 1.25 ab	6.65 ± 0.54 ab	14.30 ± 1.79 ab
K2	6.67 ± 1.02 a	6.32 ± 0.37 a	12.98 ± 1.39 a
K3	6.59 ± 0.62 a	6.32 ± 0.20 a	12.90 ± 0.82 a
K4	9.06 ± 1.29 b	7.27 ± 0.46 b	16.31 ± 1.74 b

Average ± SD: Number of Average ± standard deviation.
The used of the same *superscript* letters on the same coloumn showed that no different results between treatment at 95% significant level.

4. Discussion

Based on the analysis results, giving KNO_3 on the growth of sorghum plant on each parameter, which is calculated, has differemt results. Generally, giving KNO_3 can affect on plant growth such as the number of leaves, the weight of wet leaves, the weight of dry leaves, malai's weight, and chlorophyll content on sorghum plant. Although the optimum concentration of KNO_3 is unknown on growth of sorghum plant.

The effect of KNO_3 on some concentration, give the result that not real on all variable, except at 60% concentration (K4), give the higher results from all parameter that observed (except Chlorophyll content parameter). This shows that KNO_3 in low concentration is not showed the optimal results because there is no maximum point and decrease in growth of sorghum plant.

The research of [4] showed that KNO_3 give the effect of plant growth in increasing the number of leaves and sustain the vegetative period of *Amorphophallus muelleri*, with KNO_3 application, which are given through the leaves give the best results at 4% concentration compared application in soil, which not effect in each doses. In this connection, Reference [5] said that KNO_3 produce the best growth on vegetative growth and reproduction characteristics of strawberry plant cv. 'Merak'. The research of [6] showed that KNO_3 at 6 and 8 mM concentration with spray application also affected on vegetative growth ang reproduction of tomato plan. KNO_3 at 0,5% showed the good growth on parameter such as seed height, leaf length, leaf width, leaf area, number of leaves, number of roots of orchid plant with spray application on all parts of the plants.

Relationship between giving KNO_3 with the variable from this research can be seen from the correlation value that formed. Correlation value showed that giving KNO_3 of the number of leaves are 73,9%, the effect giving KNO_3 of the weight of wet leaves are 87,9%, the effect giving KNO_3 of the weight of dry leaves are 89,5%, the effect giving KNO_3 of malai's weight are 79,4%, the effect giving KNO_3 of chlorophyll content are chlorophyll A 16,6%, chlorophyll b 31,3%, and total chlorophyll 20,8%. The correlation results showed that there is a strong correlation between giving KNO_3 to leaf forming, the weight of wet leaves, the weight of dry leaves, and malai's weight with > 70% correlation that indicate there is strong correlation and the rest is affected by other factors. While, giving KNO_3 of chlorophyll content are < 32% (weak correlation).

Leaves are one of the important plant organs for plants. One of the important function is doing the photosynthesis. Plants that have many leaves (Table 1), it will produce heavier the weight of dry leaves. Plants that have more leaves will capture the energy of the sun for photosynthesis, it will produce much of photosynthesis results because stomata leaves will manage the inclusion of CO_2 as photosynthesis material. Asimilation of the plants can be seen from the number of flower, so the flowers as a panicles on sorghum plants is the results og plants photosynthesis. Because at the generatif growth will be allocation for seed forming on sorghum panicles. the more panicles that are formed, the more fruit (seeds) will be formed (Table 2)

On the chlorophyll content parameters, with weak correlation, it means that the content of chlorophyll of sorghum plants only slightly affected by the giving of KNO_3 (Table 3). Each treatment did not showed the significant results. Reference [7], one of the elements chlorophyll formation is nitrogen (N), which this element is needed in large amount. But, the plant can not directly used the nitrogen because the bactery must doing the fixation stages, and then the plants can use it. The results (Table 3) showed that giving KNO_3 at low concentration did not showed the significant results on chloropyhll forming. Besides nitogen, there are other factors that can be affected on chlorophyll forming, it is environmental factor such as water, light, temperature, others mterials (N, Fe, Mg, Cu, Zn, O, and sulfur) also the genetic factor of the plants. Nevertheless, the chlorophyll content which is low, plant can grow well, it can be seen on others parameter that shown the different at 60% concentration compared with other concentration, although it is not shown the significant result yet. Photosynthesis process on plant not only affected by chlorophyll content but also affected by others factor such as CO_2, light, water, and etc. However, the plants with much leaves, have better photosynthesis priduct otomatically, this is related with amount of stomata that carry out the CO_2 for photosynthesis.

The results of this research can be concluded that giving KNO_3 at high concentration (60%) can increase the growth sorghum plant on the number of leaves, freah weight of leaves, the weight of dry leaves and malai's weights, but it can not affected of chlorophyll content.

There is relation on photosynthesis product (malai's weight) on the leaves parameter that assumed of leaf forming affects plant product, as the leaf function as a place to do photosynthesis. This is showed the number of correlation leaves amount with panicles forming are 55%, it means that there is 55% relation between forming panicles with number of leaves, and the rest are affected by others factor. The correlation between malai's weight with the weight of wet leaves are 77,4%, it means that, the relation between malai's weight and the weight of wet leaves are strong correlation. The correlation between

malai's weight with the weight of dry leaves are 72,4%, it means that there are strong correlation, malai's weight are affected by the weight of dry leaves. This is showed that, the optimum concentration of KNO_3 is unknown for the growth of sorghum plants. So, need further review about KNO_3 with higher concentration, also more frequent of KNO_3 application, with the aim to get the optimum concentration, frequency, and technique application so can get the maximum output.

This is confirmed by [3] research, that increasing dose KNO3 fertilizer up to 150 kg/ha or 112.5 gr/plots produce higher height of corn crops, more amount of leaves, largest leaf area index, greater of the weight of dry leaves, more amount of lines per cob, more amount of seeds per row, higher production and higher pottasium uptake than controls.

5. Conclusion and Suggestion

5.1. Conclusion

From this research can be conclude that:

1. KNO_3 at 60% concentration (K4) showed the higher results compared with other concentration on parameter of Sorghum plant such as number of leaves, the weight of wet leaves, the weight of dry leaves, and malai's weight. However, it is no effect on chlorophyll content of leaves.
2. The optimum concentration KNO_3 is unknown for the best growth of sorghum plant.

5.2. Suggestion

Based on the results of research that has been done, needs further review about KNO_3 with higher concentration, also more frequent of KNO_3 application, with the aim to get the optimum concentration, frequency, and technique application so can get the maximum output.

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